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Observational and Biomechanical Assessment of Eating Behaviors in Autism Spectrum Disorder (ASD)

Allison Gibbons
Sacred Heart University

An Observational and Biomechanical Assessment of Eating Movement in Autism Spectrum Disorder (ASD)

EXERCISE SCIENCE
SACRED HEART UNIVERSITY

Allison Gibbons *[Mentor:. Matthew Moran]*
College of Health Professions
Department of Physical Therapy and Human Movement Science

ABSTRACT

Autism Spectrum Disorder (ASD) is typically diagnosed as a social developmental delay disorder. However, research shows the presence of gross and fine motor skill deficits that potentially affect activities of daily living (ADL) such as eating, reaching & grasping. [1,2] **PURPOSE**: This study analyzed eating behaviors to understand the impact motor deficits have in ASD as an integral component of diagnosis. **METHODS**: 19 subjects (9 with ASD, 10 without ASD; 19.0 ± 2.1 yo (ASD), 19.8 ± 2.3 yo (without ASD); 79% male) were recruited and granted informed consent prior to participating in this study. Hi-speed video recording (210 Hz) was taken in both the frontal and sagittal plane of each subject eating a soft substance. One hand was to remain holding the container containing the food while the other hand grasped a spoon to perform the eating task. No instructions were given to participants as to how to hold the container or spoon. A novel qualitative assessment of eating posture was completed by two raters. The rubric assessed seven items related to the subjects' grasping and eating posture. Kinovea software was utilized to assess: 1) temporal analysis of the spoon leaving the container to the spoon entering the mouth; 2) distance from container to mouth; and 3) trunk flexion when the spoon entered the mouth. SPSS software was used to run Chi Square and unpaired t-tests in order to examine qualitative and biomechanical differences between control and experimental groups **RESULTS:** There were no significant biomechanical differences between trunk flexion (p= 0.09) and time eating (p=0.17) between groups. Also, there were no observed significant differences between spoon position (p=0.28), trunk flexion (p=0.46), and contralateral arm positioning (p=0.09) between groups. There were significant differences in distance from container to mouth (p<0.01), tripod grasp (p<0.01), and extraneous movements (p<0.01). **CONCLUSIONS:** Although there was not significance in every area assessed, it is evident that there are motor impairments in individuals with ASD that negatively modify eating movement. The inability to carry out motor planning for sequential movements may be a cause of motor deficits in the reach to grasp movement during eating.[2] This research suggests that motor "delays" in ASD may actually be life-long deficits. Further research must be done in order to observe whether individuals with severe ASD have the ability to improve these fine and gross motor skills over time or if their cognitive inability to plan motor tasks will continually hinder motor skill development. [2,3]

What is a Developmental Delay?

One prominent symptom in ASD is a delay in developmental milestones. Delays in milestones suggest the ability to improve over time. In this study multiple ASD subjects exemplified symptoms suggesting that they have yet to master these motor skills. [3,4]

According to the CDC, at 18 months old a child should be able to eat with a spoon. At age four a child should be able to mash his or her own food. Some subjects at ages 19.0 ± 2.1 yo struggled using a spoon and/or needed assistance in mashing their food prior to consumption. This suggests these claimed developmental delays may be permanent motor skill deficits. [5]

Who Gets ASD?

Although the etiology is not yet understood, there are some risk factors for ASD: [4]

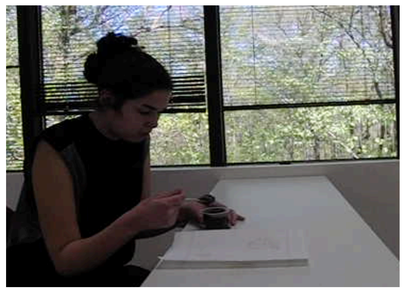
- Particular genes or particular genetic conditions
- Having a sibling with ASD
- Being a male (males are 4.5 times more likely to have ASD than females)
- ASD exists amongst all races and ethnicities
- ASD currently affects about one in every 68 children in the United States. [6]

PARTICIPANTS

Nine subjects diagnosed with ASD (8 male and 1 female, ages 19.0 ± 2.1 yo) were recruited and granted informed consent prior to participating in the study. 10 subjects, seven males and three females, ages 19.8 ± 2.3 yo without ASD served as a control group.

METHODS

All ASD subjects participated in the Childhood Autism Rating Scale (CARS) assessment. In this study all subjects scored within the range of severe ASD (average: 51.11 ± 18.0). Subjects were seated and asked to keep one hand on the container while the contralateral hand grasped the spoon used to eat. No instructions were given to subjects as to how to hold the container or food.



A novel assessment rubric to examine posture and feeding conduct in ASD compared to age matched controls was completed by two researchers. Biomechanical measures assessed were: 1) temporal analysis of the spoon leaving the container to the spoon entering the mouth (seconds); 2) distance from container to spoon entering mouth (pixel distance); and 3) trunk flexion when the spoon entered the mouth relative to the angle of horizontal (degrees). Biomechanical measures were taken for five consecutive eating trials and then averaged for each participant.

RESULTS

Subject Code	Focus	Hand	Dynamic Lateral Tripod Grasp	Spoon Position	Trunk Posture	Contralateral Hand & UE Position	Extraneous Movements
E2	No	Right	No	Upright	Flexed Forward	Holding Container with elbow on table	Yes
E3	No	Right	Yes	Upright	Flexed Forward	Other	Yes
E4	No	Right	No	Upright	Flexed Forward	Holding Container with elbow on table	Yes
E5	Yes	Right	No	Upright	Flexed Forward	Holding Container with elbow on table	No
E6	No	Right	No	Upright	Flexed Forward	Other	Yes
E7	Yes	Right	No	Flipped	Upright	Holding Container midway between table and mouth	Yes
E8	No	Right	No	Upright	Flexed Forward	Holding Container with forearm on table	Yes
E9	No	Right	No	Upright	Upright	Other	Yes
E10	Yes	Right	No	Upright	Upright	Holding Container close to mouth	No

Subject Code	Focus	Hand	Dynamic Lateral Tripod Grasp	Spoon Position	Trunk Posture	Contralateral Hand & UE Position	Extraneous Movements
C1	Yes	Right	Yes	Upright	Upright	Holding Container with forearm on table	No
C2	Yes	Right	Yes	Upright	Flexed Forward	Holding Container with forearm on table	No
C3	Yes	Right	Yes	Upright	Upright	Other	No
C4	Yes	Right	Yes	Upright	Upright	Holding Container with forearm on table	No
C5	Yes	Right	Yes	Upright	Flexed Forward	Holding Container with forearm on table	No
C6	Yes	Right	Yes	Upright	Flexed Forward	Holding Container with elbow on table	No
C7	Yes	Right	Yes	Upright	Flexed Forward	Holding Container with forearm on table	No
C8	Yes	Right	Yes	Upright	Upright	Holding Container with forearm on table	No
C9	Yes	Right	Yes	Upright	Flexed Forward	Holding Container with forearm on table	No
C10	Yes	Right	Yes	Upright	Upright	Holding Container with forearm on table	No

Subject Code	Temp Analysis (Seconds)	Distance Analysis (px)	Trunk Flexion (degrees)
C1	0.8952	119.592	83.58
C2	0.9076	78.96	70.08
C3	0.991	98.418	72.08
C4	1.8504	99.582	76.42
C5	1.4542	120.534	75.66
C6	0.9296	55.308	55.56
C7	1.3248	104.996	75.04
C8	2.2642	134.33	67.16
C9	0.9482	88.872	70.72
C10	1.0472	149.84	89.2
Average	1.3	105.0	73.6
SD	0.5	27.5	9.1

Subject Code	Temp Analysis (Seconds)	Distance Analysis (px)	Trunk Flexion (degrees)
E2	2.3696	38/786	62.2
E3	4.8296	68.252	52.7
E4	5.7616	59.82	67.04
E5	0.6868	51.824	66.46
E6	3.6162	95.892	65.08
E7	0.8792	23.834	n/a
E8	1.34	79.692	77.72
E9	0.593	90.8	n/a
E10	0.7912	26.718	n/a
Average	2.318577778	62.104	65.2
SD	2.0	27.1	8.1

DISCUSSION

The results of this study showed that there are multiple flawed eating behaviors in individuals with ASD including: 1) maintaining a tripod grasp, 2) avoiding extraneous activity and, 3) establishing proper distance from mouth and container with food.

Only one individual with ASD was able to employ a tripod grasp. Individuals with ASD are unable to execute proper motor planning. [2,7]Sequential movements such as eating are processed in individual steps. This inability to plan a continuous movement could result in an improper grasping and positioning. [1,2,8]

It was thought that individuals with ASD would have increased trunk flexion but there was no significance shown in this study. [9] However, three ASD subjects were unable to contribute to the biomechanical analysis of trunk flexion due to the inability to adequately assess his or her positioning. If their data was attainable there may have been significance in trunk flexion between the groups.

While performing the eating task, there were other people walking about the room not engaging in the eating activity allowing for additional distraction. However, this embodiment created a natural environment in which individuals would typically eat. The presence of extraneous activity and lack of focus while eating in this natural setting suggests the difficulty the ASD cognitive system has in motor planning. [1,2,7]

TAKE HOME MESSAGES

- Inability of cognitive motor planning led to motor skill impairments in the reach to grasp movement of eating.[2,3,7]
- A symptom of ASD is delay in developmental milestones implying that individuals will eventually improve. However, these young adults with severe ASD still exemplify motor skill impairments suggesting there are concrete motor deficits as opposed to delays.[2,5,10]
- Motor milestone delays may increase presence of other motor skill deficits such as reaching to grasp movement. If an ASD individual is delayed in grasping a spoon they may be spoon fed and thus fail to practice the reaching portion of the movement as well as the grasping. [2,5,10,11]
- More research must be done to understand whether these distinctions are due to cognitive deficits in motor planning and execution, or whether there may be an additional musculoskeletal component such as hypotonia. [3,7,12,13]

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